# PROMOTION OF ROOTING IN ROOT CUTTING PROPOGATION

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Technical Paper

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| TO: | J. F. McLaughlin, Director<br>Joint Highway Research Project | September 7, 1972 |
| | | Project: C-36-48C |
| FROM: | H. L. Michael, Associate Director<br>Joint Highway Research Project | File: 9-5-3 |

The Technical Paper attached has been prepared by Mr. R. E. McNiel from the research conducted under Part II of the HPR Part II Research Project "Research in Roadside Development and Maintenance". The Paper is titled "Promotion of Rooting in Root Cutting Propagation". The material contained in the Paper has previously been submitted and accepted by the Board in an Interim Report.

The Paper is proposed for publication in the Journal of the International Plant Propagator's Society.

The Paper is submitted for approval of such publication. It will also be forwarded to the ISHC and FHWA for review, comment and approval of publication.

Respectfully submitted,

Harold L. Michael

Harold L. Michael
Associate Director

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Technical Paper

# PROMOTION OF ROOTING IN ROOT CUTTING PROPAGATION

by

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Purdue University
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PROMOTION OF ROOTING IN ROOT CUTTING PROPAGATION

Abstract. Due to shoots developing without the formation of roots during the propagation of some species propagated from root cuttings, growth promoting compounds were applied to root cuttings of *Rhus glabra*, *Sassafras albidum* and *Comptonia peregrina* in order to develop roots. IBA (3-indolebutyric acid), B-Nine (succinic acid-2,2-dimethylhydrazide) and Ethrel (2-chloroethylphosphonic acid) did not cause an increase in the number of cuttings rooted, however, IBA did cause an increase in the number of roots per rooted cutting.

Observations from published (7) and unpublished propagation research have shown that certain woody plant species when propagated from root cuttings will develop shoot growth of a few centimeters without developing a root system. The shoot growth eventually died since the root system did not develop and the result was the lost of a useable plant from each cutting. The purpose of the following research was to determine which growth promoting compounds or combinations would induce root development in woody species.

Auxin at high concentration has been reported to be a strong inhibitor of root development (6,5) except in a few special cases (4,6). Fretz and Davis (4) found greater adventitious root formation with a species of Ilex and Juniper at 2500 and 5000 ppm concentrations applied as a dip. At low concentrations ($10^{-10}$M), auxin has been found to stimulate root development in special cases (15).

Went (11) originally suggested that factors other than auxin were needed to promote root formation. Little about these other factors has been made completely clear since then, but many compounds and theories have been explored. One category of compounds explored has been phenolic acid used as a synergist with auxin. Leopold (6) and Zenk and Muller (14) have classified the phenolic acids into groups which affect decarboxylation of auxin and those which inhibit growth. Even though salicylic acid has been listed as a growth inhibitor with no synergistic effect (6), Basu, Bose, Roy and Mukhopudhyay (1) found it promoted rooting in combination with auxins.

Ethylene is also classified as a growth substance and has the following effects on root systems: 1) inhibits the elongation of growth in roots, 2) induces the formation of root-hair (10). In addition, workers have found root development to have been affected directly and indirectly by auxin as it affects ethylene and vice versa (2,10,12).

Antimetabolites (B-Nine and others) were first found to inhibit or be ineffective in root formation and development of herbaceous cuttings (3). Recently, however, Reed and Hoysler (8,9) found B-Nine to promote rooting on stem cuttings of three floral crops while other antimetabolites had no effect.

Due to these findings an auxin, an auxin synergist, ethylene and an antimetabolite were selected to study their influence in the promotion of root initiation and development on root cuttings of Rhus glabra L., Comptonia peregrina (L.) Coult., and Sassafras albidum (Nutt.) Ness.

## MATERIALS AND METHODS

The plant species chosen were selected for two reasons. C. peregrina and S. albidum were used because of their ability to produce shoot growth without a root system. R. glabra was selected as a control because it had been very successful in its ratio of new plants produced per cuttings planted in earlier studies.

Cuttings from each species were identified to be root tissue by the use of microscopic techniques. C. peregrina roots were obtained from 100 plants, which were collected natively from within the state of Connecticit. R. glabra cuttings were taken from three

nursery grown plants, which were five years old, and *S. albidum* cuttings were removed from one young native tree. Both of the later plants were obtained in the Lafayette, In. area.

All plants were dug between November 15-19, 1971. While not in transit, all roots were kept at 38°F. Root cuttings for treatment were taken 7 days after digging.

Cuttings were made between 7 and 8 centimeters in length with the diameter varying between 3 and 10 millimeters. Treated cuttings were placed in six-inch deep flats containing a peat:perlite mixture (1:1 v/v). The potting mixture was kept moist by daily hand watering.

Solutions of IBA (3-indolebutyric acid), B-Nine (succinic acid-2,2-dimethylhydrazide), Ethrel (2,chloroethylphosphonic acid) and salicylic acid were applied to the root cuttings at various concentrations and by different application techniques. Ethrel, breaks down evolving ethylene (13) and was the ethylene source. Foliar applications of Ethrel at 50 or 100 ppm or B-Nine at 100 ppm also were made after 2-4 leaves developed on new shoot growth. These cuttings were initially treated with a 15-second dip in deionized water prior to planting and growth development. Controls consisted of a soak for 25 hours and a dip for 15 seconds in deionized water. Table 1 lists all treatments used. All cuttings were submerged during treatment and then allowed to dry for 15-30 minutes prior to planting.

All treatments were replicated 5 times with each replication containing 5 cuttings. Rooting and growth data was taken 16-17 weeks after planting. Data included number of shoots formed, per-

centage of cuttings forming shoots, number roots per cutting, and number of cuttings rooted.

## RESULTS AND DISCUSSION

Only fragmented results occured with root cuttings from *R. glabra* and *S. albidium* when treated with growth promoting substances (Table 2 and Table 3). The poor response by *R. glabra* may be due to having a root system too old for good propagation. Hartmann and Kester (5) explained as one of the reasons for the failure of plants to be rejuvenated by root cuttings was because the root pieces were too old. Root cutting propagation of *S. albidium* is still a mystery. Of the responses, from *S. albidium*, cuttings produced both shoots and root, others shoot only, and still others root only. No treatments provided a satisfactory increase in rooting of these two plants.

*C. peregrina* responded extremely well to being propagated by root cuttings during November in a greenhouse. There were no differences in the number of cuttings forming shoots or forming roots between treatments and controls (Table 4). A difference in the number of roots produced did occur.

IBA at 2500 and 5000 ppm increased the number of roots as did the treatment of salicylic acid plus IBA at 2500 ppm (Table 5). Not enough evidence is present to differentiate between a synergistic effect of salicylic acid and the response due solely to IBA at 2500 ppm. Rooting was also influenced by Ethrel at 1000 ppm.

Of the treatments used, none proved to overcome the phenomenon whereby cuttings produce shoots but no roots. However, with *C.*

*peregrina* the number of roots produced per cutting was increased when the growth promoting substance IBA was applied at 2500 and 5000 ppm and Ethrel at 1000 ppm.

*peregrina* the number of roots produced per cutting was increased when the growth-promoting substance IAA was applied at 2500 and 5000 ppm and Ethrel at 1000 ppm.

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Table 1. Treatments applied to root cuttings.

| Material | Conc. ppm | Method of Application | Application Time |
|---|---|---|---|
| Deionized Water | | dip | 15 sec. |
| Deionized Water | | soak | 25 hr. |
| IBA | 1 | soak | 25 hr. |
| IBA | 10 | soak | 25 hr. |
| IBA | 1,000 | dip | 15 sec. |
| IBA | 2,500 | dip | 15 sec. |
| IBA | 5,000 | dip | 15 sec. |
| B-Nine | 1 | soak | 25 hr. |
| B-Nine | 10 | soak | 25 hr. |
| B-Nine | 1,000 | dip | 15 sec. |
| B-Nine | 2,500 | dip | 15 sec. |
| B-Nine | 5,000 | dip | 15 sec. |
| Ethrel | 1 | soak | 25 hr. |
| Ethrel | 10 | soak | 25 hr. |
| Ethrel | 1,000 | dip | 15 sec. |
| Ethrel | 2,500 | dip | 15 sec. |
| Ethrel | 5,000 | dip | 15 sec. |
| Salicylic Acid | 10 | soak | 25 hr. |
| Salicylic Acid<br>+ IBA | 10<br>1,000 | soak<br>dip | 25 hr.<br>15 sec. |
| Salicylic Acid<br>+ IBA | 10<br>2,500 | soak<br>dip | 25 hr.<br>15 sec. |
| B- Nine | 100 | foliar | |
| Ethrel | 50 | foliar | |
| Ethrel | 100 | foliar | |

Table 2. Response of *Rhus glabra* root cuttings to root promoting substances.

| Treatment | No. of Shoots Formed | % of Cuttings Forming Shoots | No. of Roots Formed | % of Cuttings Rooted |
|---|---|---|---|---|
| IBA 1 ppm | 15 | 28 | 18 | 24 |
| IBA 10 ppm | 15 | 36 | 9 | 20 |
| IBA 1000 ppm | 25 | 52 | 1 | 4 |
| IBA 2500 ppm | 43 | 76 | 10 | 24 |
| IBA 5000 ppm | 6 | 20 | 14 | 16 |
| B-Nine 1 ppm | 13 | 32 | 3 | 8 |
| B-Nine 10 ppm | 16 | 44 | 16 | 28 |
| B-Nine 1000 ppm | 8 | 28 | 17 | 24 |
| B-Nine 2500 ppm | 39 | 64 | 30 | 36 |
| B-Nine 5000 ppm | 19 | 48 | 5 | 12 |
| Ethrel 1 ppm | 24 | 68 | 21 | 36 |
| Ethrel 10 ppm | 5 | 16 | 3 | 4 |
| Ethrel 1000 ppm | 8 | 32 | 10 | 8 |
| Ethrel 2500 ppm | 29 | 60 | 12 | 20 |
| Ethrel 5000 ppm | 2 | 8 | 6 | 8 |
| Salicylic acid | 14 | 36 | 8 | 20 |
| Sali acid-IBA 1000 ppm | 40 | 64 | 21 | 36 |
| Sali acid-IBA 2500 ppm | 25 | 48 | 4 | 12 |
| $H_2O_{15}$--B-Nine 100 ppm | 20 | 64 | 41 | 40 |
| $H_2O_{15}$--Ethrel 50 ppm | 30 | 52 | 19 | 16 |
| $H_2O_{15}$--Ethrel 100 ppm | 2 | 8 | 1 | 4 |
| $H_2O$--15 sec. dip | 26 | 60 | 16 | 28 |
| $H_2O$--24 hr. soak | 14 | 36 | 21 | 32 |

Table 3. Response of Sassafras albidium root cuttings to root promoting substances.

| Treatment | No. of Shoots Formed | % of Cuttings Forming Shoots | No. of Roots Formed | % of Cuttings Rooted |
|---|---|---|---|---|
| IBA 1 ppm | 0 | 0 | 0 | 0 |
| IBA 10 ppm | 1 | 4 | 3 | 4 |
| IBA 1000 ppm | 0 | 0 | 0 | 0 |
| IBA 2500 ppm | 3 | 12 | 2 | 8 |
| IBA 5000 ppm | 3 | 12 | 10 | 16 |
| B-Nine 1 ppm | 0 | 0 | 0 | 0 |
| B-Nine 10 ppm | 1 | 4 | 0 | 0 |
| B-Nine 1000 ppm | 0 | 0 | 6 | 12 |
| B-Nine 2500 ppm | 2 | 8 | 2 | 8 |
| B-Nine 5000 ppm | 3 | 8 | 4 | 16 |
| Ethrel 1 ppm | 4 | 8 | 4 | 8 |
| Ethrel 10 ppm | 0 | 0 | 1 | 4 |
| Ethrel 1000 ppm | 0 | 0 | 0 | 0 |
| Ethrel 2500 ppm | 0 | 0 | 0 | 0 |
| Ethrel 5000 ppm | 1 | 4 | 1 | 4 |
| Salicylic acid | 0 | 0 | 0 | 0 |
| Sali acid--IBA 1000 ppm | 0 | 0 | 0 | 0 |
| Sali acid--IBA 2500 ppm | 1 | 4 | 8 | 8 |
| $H_2O_{15}$--B-Nine 100 ppm | 3 | 12 | 8 | 12 |
| $H_2O_{15}$--Ethrel 50 ppm | 1 | 4 | 12 | 24 |
| $H_2O_{15}$--Ethrel 100 ppm | 2 | 8 | 10 | 20 |
| $H_2O$--15 sec. dip | 2 | 8 | 7 | 4 |
| $H_2O$--24 hr. soak | 1 | 4 | 1 | 4 |

Table 4. Response of <u>Comptonia</u> <u>peregrina</u> root cuttings to root promoting substances.

| Treatment | No. of Shoots Formed | % of Cuttings Forming Shoots | Ave. No. of roots per rooted cutting | % of Cuttings Rooted |
|---|---|---|---|---|
| IBA 1 ppm | 28 | 72 | 6.2 | 84 |
| IBA 10 ppm | 38 | 96 | 6.4 | 92 |
| IBA 1000 ppm | 32 | 84 | 5.9 | 88 |
| IBA 2500 ppm | 31 | 80 | 8.2 | 76 |
| IBA 5000 ppm | 35 | 92 | 11.5 | 92 |
| B-Nine 1 ppm | 40 | 80 | 6.0 | 96 |
| B-Nine 10 ppm | 44 | 80 | 3.8 | 80 |
| B-Nine 1000 ppm | 36 | 84 | 5.7 | 100 |
| B-Nine 2500 ppm | 33 | 76 | 5.5 | 60 |
| B-Nine 5000 ppm | 23 | 76 | 4.6 | 88 |
| Ethrel 1 ppm | 37 | 84 | 5.7 | 84 |
| Ethrel 10 ppm | 30 | 64 | 4.8 | 76 |
| Ethrel 1000 ppm | 34 | 80 | 9.0 | 72 |
| Ethrel 2500 ppm | 30 | 60 | 4.7 | 84 |
| Ethrel 5000 ppm | 27 | 52 | 4.5 | 72 |
| Salicylic acid | 46 | 100 | 4.3 | 92 |
| Sali acid--IBA 1000 ppm | 29 | 80 | 6.6 | 76 |
| Sali acid--IBA 2500 ppm | 31 | 84 | 8.7 | 100 |
| $H_2O_{15}$--B-Nine 100 ppm | 10 | 45 | 3.5 | 75 |
| $H_2O_{15}$--Ethrel 50 ppm | 39 | 80 | 3.8 | 72 |
| $H_2O_{15}$--Ethrel 100 ppm | 24 | 70 | 5.0 | 75 |
| $H_2O$--15 sec. dip | 25 | 68 | 3.0 | 56 |
| $H_2O$--24 hr. soak | 34 | 80 | 4.0 | 84 |

Table 5. Number of roots formed on C. *peregrina* root cuttings when treated with root promoting substances.[z]

| Material | | Ave. No. of roots formed per replication |
|---|---|---|
| IBA | 5000 | 53.2 a |
| Salicylic Acid + IBA | 2500 | 43.4 ab |
| Ethrel | 1000 | 32.4 bc |
| IBA | 2500 | 31.2 bc |
| IBA | 10 | 29.6 bc |
| B-Nine | 1 | 28.8 bcd |
| B-Nine | 1000 | 28.6 bcd |
| IBA | 1 | 26.2 bcd |
| IBA | 1000 | 25.8 bcd |
| Salicylic Acid + IBA | 1000 | 25.0 bcd |
| Ethrel | 1 | 23.8 bcd |
| B-Nine | 5000 | 20.2 cd |
| Ethrel | 2500 | 19.8 cd |
| Salicylic Acid | | 19.8 cd |
| Ethrel | 100 | 18.8 cd |
| Ethrel | 10 | 18.2 cd |
| $H_2O$ soak | | 17.0 cd |
| B-Nine | 2500 | 16.6 cd |
| Ethrel | 5000 | 16.2 cd |
| B-Nine | 10 | 15.2 cd |
| Ethrel | 50 | 13.6 cd |
| B-Nine | 100 | 13.0 cd |
| $H_2O$ dip | | 8.2 d |

[z]Means in each column with different letters differ at the 1% level.